

Permanent Learning and the construction of effective Sixth Form timetables

Our aim is the transference of knowledge into the long-term memory and the ability to quickly and accurately retrieve this



Stage Analysis of Memory



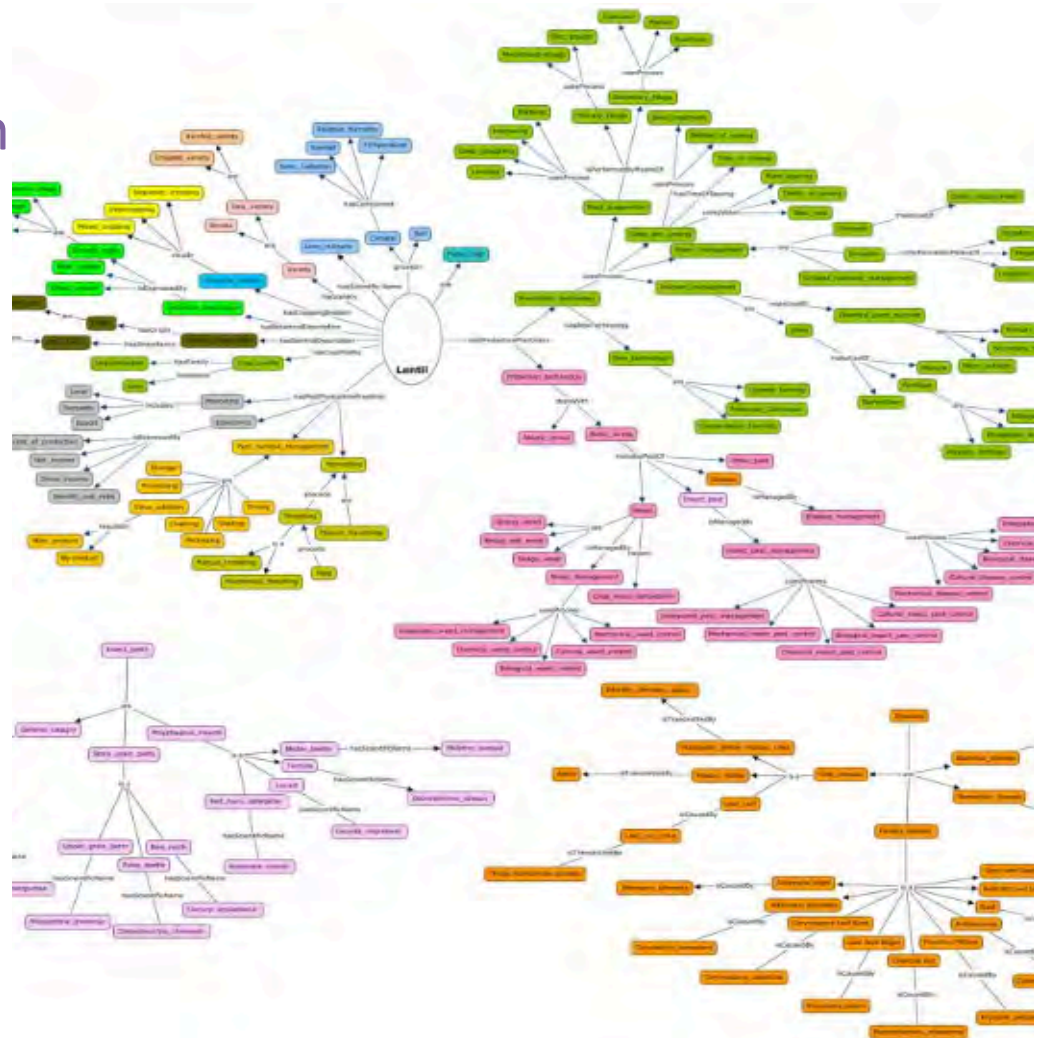
- Encoding
 - Storing a memory trace
 - Perception leaves representation in memory
- Storage
 - retaining trace in memory
 - latent, available for use
- Retrieval
 - recovering encoded trace from storage
 - using available knowledge in cognition/action

Stage 1: learning needs to be encoded

This is connecting new information that you learn into your existing knowledge framework



Encoding



A large and highly organised knowledge framework is vital to academic success

*Breadth of knowledge is the single factor within
human control that contributes most to
academic achievement, E D Hirsch*



Encoding

Knowledge Organisers

Hence the importance of Knowledge Organisers and highly effective folder management to develop your personal **Knowledge Framework**. Encoding time should be built into your timetable to create highly organised knowledge.



Encoding

expressed mathematically, entropy is a measure of disorder

Standard molar entropy, S^\ominus , is the entropy of a substance per mole under standard conditions.

Whether a process is spontaneous or not depends on these factors: **Temperature**, entropy change of the **system** and the entropy change of the **surroundings**.

The entropy change of a system can be calculated using the standard entropies of products and reactants.
 $\Delta S^\ominus_{\text{system}} = \sum S^\ominus_{\text{products}} - \sum S^\ominus_{\text{reactants}}$

We can predict whether $\Delta S^\ominus_{\text{system}}$ will be positive or negative.
 $\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_2\text{O}_{(g)}$ is positive as a gas is formed from a liquid.
 $\text{N}_2\text{O}_{(g)} \rightarrow 2\text{NO}_{(g)}$ is positive as 2 molecules of gas are formed from one molecule of gas.
 $\text{H}_2\text{O}_{(g)} + \text{H}_{2(g)} \rightarrow \text{H}_2\text{O}_{(l)}$ is negative as a liquid is formed from a gas.

Entropy of the surroundings is determined by the size of the enthalpy change ΔH and the temperature (in kelvin).
 $\Delta S^\ominus_{\text{surroundings}} = -\Delta H/T$ NB: ΔH is in KJmol^{-1} so need to $\times 1000$

ΔH is the enthalpy change of reaction and can be calculated using Hess law: $\Delta H_r = \sum \Delta H_f(\text{products}) - \sum \Delta H_f(\text{reactants})$

The total entropy change $\Delta S^\ominus_{\text{total}}$ is the sum of the entropy of the system and entropy of the surroundings.
 $\Delta S^\ominus_{\text{total}} = \Delta S^\ominus_{\text{system}} + \Delta S^\ominus_{\text{surroundings}}$
 A reaction will be feasible when $\Delta S^\ominus_{\text{total}}$ is positive.

In an endothermic reaction, an increase in temperature results in an increase in $\Delta S^\ominus_{\text{surroundings}}$ hence $\Delta S^\ominus_{\text{total}}$ increases. In an exothermic reaction, an increase in temperature results in a decrease in $\Delta S^\ominus_{\text{surroundings}}$ hence $\Delta S^\ominus_{\text{total}}$ decreases.

Whether a solid will dissolve depends on the balance between $\Delta S^\ominus_{\text{system}}$ and $\Delta S^\ominus_{\text{surroundings}}$. $\Delta S^\ominus_{\text{surroundings}}$ for dissolving takes into account the value of $\Delta H_{\text{solution}}$ and the temperature as $\Delta S^\ominus_{\text{surroundings}} = -\Delta H_{\text{solution}}/T$

The enthalpy of solution is calculated by:
 $\Delta H_{\text{solution}} = \sum \Delta H_{\text{hydration}} - \sum \Delta H_{\text{formation}}$

Entropy knowledge organiser

The enthalpy of hydration of a Mg^{2+} ion is more exothermic than Na^+ because the Mg^{2+} ion is smaller and has a higher charge so it attracts the water more strongly. The enthalpy of hydration of a Cl^- ion is more exothermic than a Br^- ion because Chloride ions are smaller so the force of attraction between chloride ions and the H_2O is stronger.

Sodium chloride dissolves readily in water despite the fact that it is an endothermic process. If $\Delta H_{\text{solution}}$ is positive, then $\Delta S^\ominus_{\text{system}}$ is negative. But $\Delta S^\ominus_{\text{surroundings}}$ is positive (because there is an increase in disorder from $\text{NaCl}_{(s)}$ to $\text{NaCl}_{(aq)}$) and $\Delta S^\ominus_{\text{surroundings}}$ outweighs $\Delta S^\ominus_{\text{system}}$, hence $\Delta S^\ominus_{\text{total}}$ is positive so sodium chloride dissolves.

The free energy change ΔG is the balance between entropy, enthalpy and temperature. It is known as Gibbs free energy and a process can occur spontaneously when $\Delta G < 0$.

$\Delta G = \Delta H - T\Delta S_{\text{system}}$ units of ΔG are KJmol^{-1}

ΔH	ΔS	ΔG	Feasibility
-ve	+ve	Always -ve	Feasible
-ve	-ve	Only -ve if $\Delta H > T\Delta S$	Feasible at low temps
+ve	+ve	Only -ve if $T\Delta S > \Delta H$	Feasible at high temps
+ve	-ve	Always +ve	Never feasible

Some reactions are thermodynamically feasible (as ΔG is negative) but are very slow. They are said to be thermodynamically unstable but kinetically inert because

Folder management

An effective folder assists the learning process by ensuring that work is complete and clearly organised in a manner that optimises:

- a. Effective understanding of required knowledge/ skills
- b. Effective transfer of required knowledge/ skills into the long-term memory
- c. Effective recall of required knowledge/ skills



Encoding



Folder management check list

1. It uses **effective organisational devices**: hard back folder, dividers, plastic wallets or ring-reinforcers, tabs, hole punch, post its, colour etc. to promote a-c above
2. It is in **good working order and fit for purpose** – no broken ring binders, pages falling out etc.
3. It is organised **exactly following the manner outlined by the subject teachers** at the front of each subject folder which will be based on a-c above: It contains the clear sections that subject teachers have requested separated by dividers: for example it may contain separate sections for assessed work
4. It is **in school and in lessons with the student**, not left at home as it plays a key role in the daily learning process
5. It is **organised by unit** with all unit information kept together to assist complete learning of any unit studied, and it contains all unit work: for example previous assessments are not thrown away but kept in the section directed by the teacher
6. It contains **clear sign posting** to assist with a-c above in a manner agreed with the subject teachers e.g. signposting of homework done/ handed in
7. It **demonstrates engagement with learning** in line with a-c above e.g. RAG-ing work, Response Tasks in a different colour and clearly completed, evidence of going back over learning to review and consolidate this
8. It contains sections for **wider reading**

Green: meets all 8 criteria above

Amber: meets criteria 1-7 above

Red: meets criteria 1-5 above

Purple: fails to meet criteria 1-5 above

2. Learning needs to be stored in the long-term memory

Your course completion hours will be based on the number of hours you need to practice to achieve A Level/ BTEC success. **This practice time needs to be built into your timetable**

This involves **practising deliberately:**

Classwork

Homework

Reading

For knowledge or skills to be stored permanently you need to 'overlearn'

information by about **20%**



Storage

Deliberate practice

Deliberate practice refers to a special type of practice that is purposeful and systematic. While regular practice might include mindless repetitions or your attention drifting, deliberate practice requires focus attention and concentration and is conducted with the specific goal of improving performance.

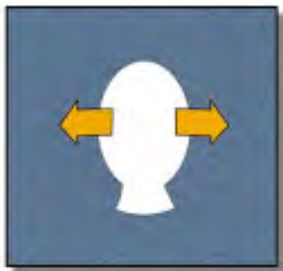


Storage



3. Learning needs to be quickly and accurately retrievable from the long-term memory

This is achieved through regular retrieval activities such as testing. These should be built into your timetable.



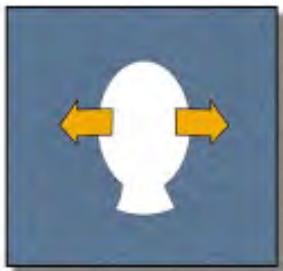
Retrieval

**RETRIEVAL
PRACTICE**

**THE MOST POWERFUL LEARNING
STRATEGY YOU'RE NOT USING**

Benefits of testing (Roediger *et al.* study)

1. It helps you to retrieve knowledge more quickly and easily
1. **It is the ONLY way that you will know what you don't know**
Studies found that testing reduced students' confidence even while aiding their performance.
3. The more you test yourself, the greater the **Testing Effect** of improved performance



Retrieval

Find out more here ...

WHAT WORKS, WHAT DOESN'T

Some study techniques accelerate learning, whereas others are just a waste of time—but which ones are which? An unprecedented review maps out the best pathways to knowledge

BY JOHN DUNLOSKY, KATHERINE A. RAWSON, ELIZABETH J. MARSH, MITCHELL J. NATHAN AND DANIEL T. WILLINGHAM

ILLUSTRATIONS BY CELIA JOHNSON

<https://teachingacademy.wisc.edu/what-are-the-best-ways-to-study-read-this-review-from-scientific-american/>

Or here ...



<https://teacherhead.com/2017/06/15/beyond-growth-mindset-two-videos/>